

Data Communication and Net-Centric Computing

COSC 1111/2061/1110

Lecture 11

Transport Protocols

Lecture Overview

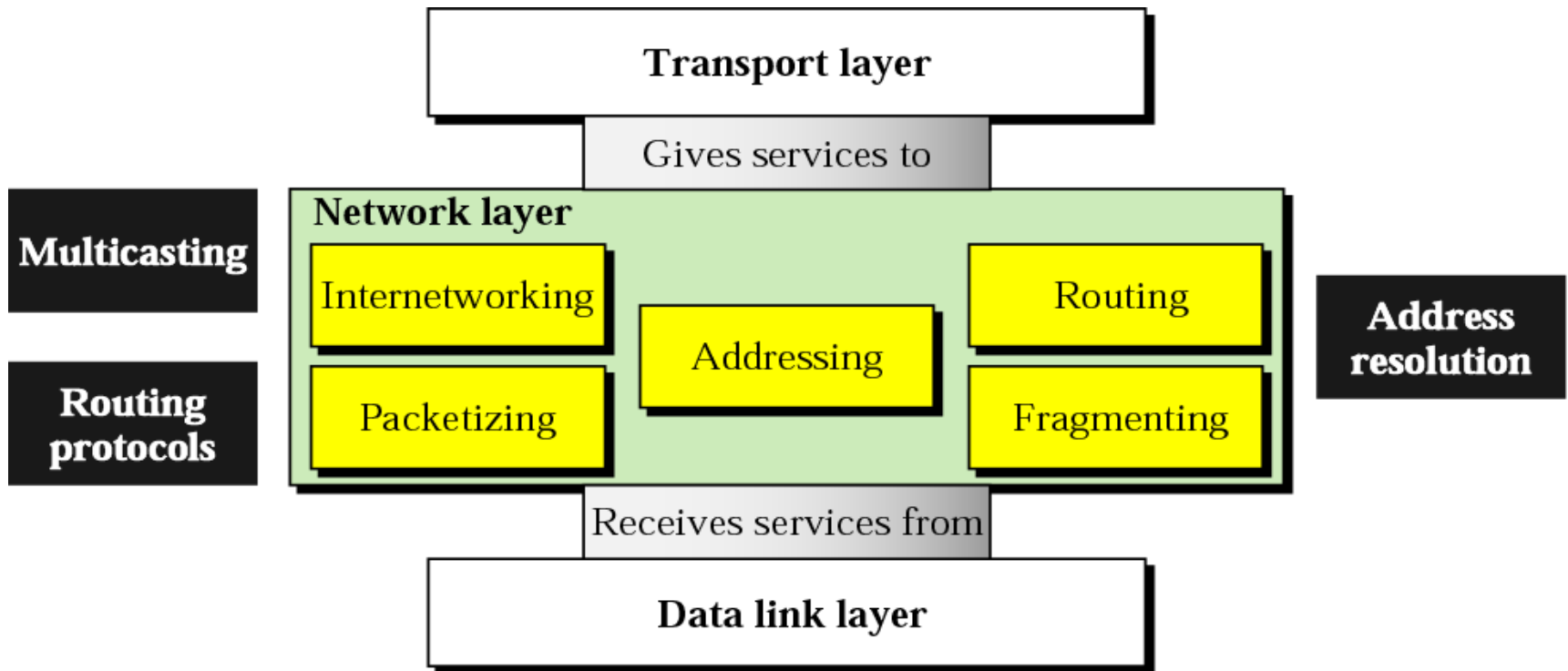
❖ During this lecture, we will

- Understand Transport protocols (TCP/UDP)
- Briefly review the course
- Discuss exam Question paper

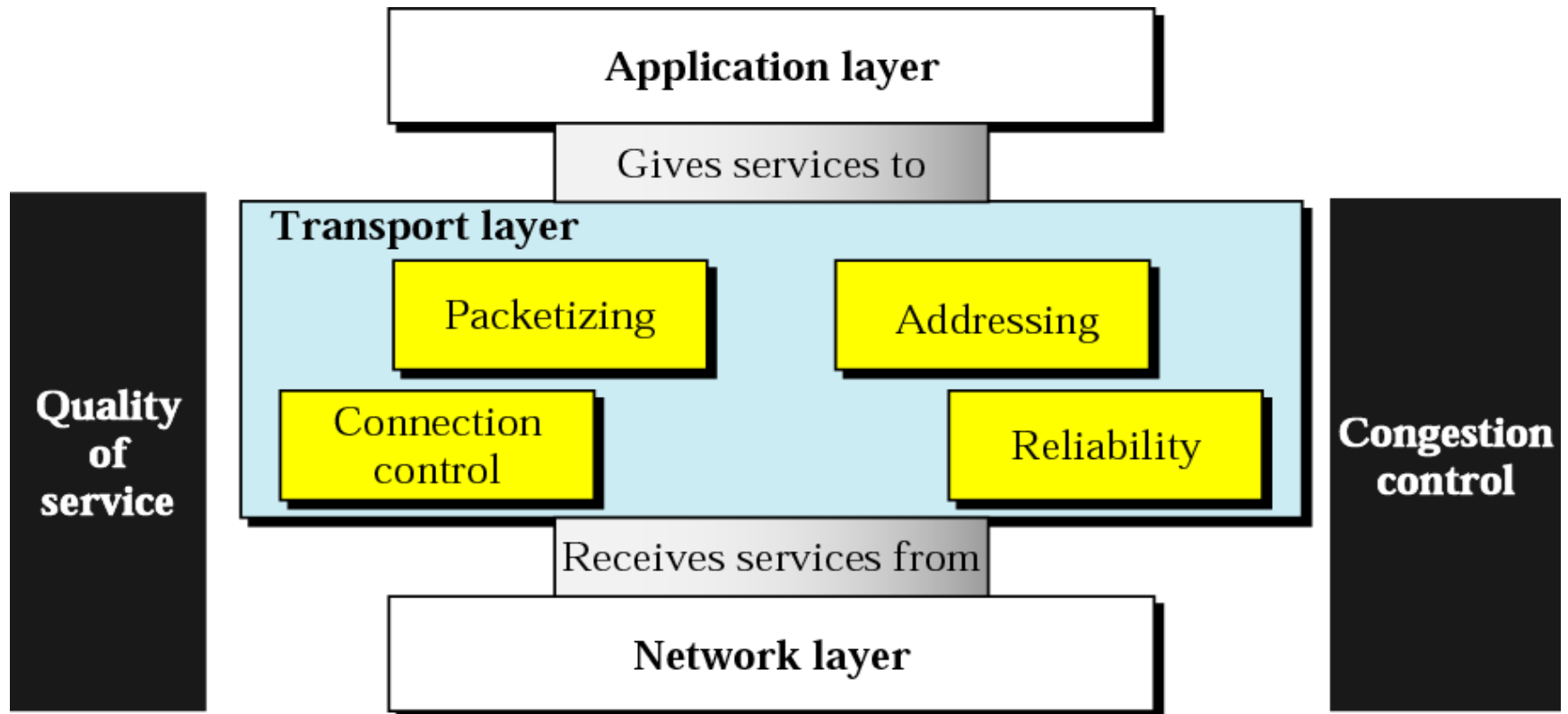
❖ Recommended reading

- Chapter 20 (Stallings)

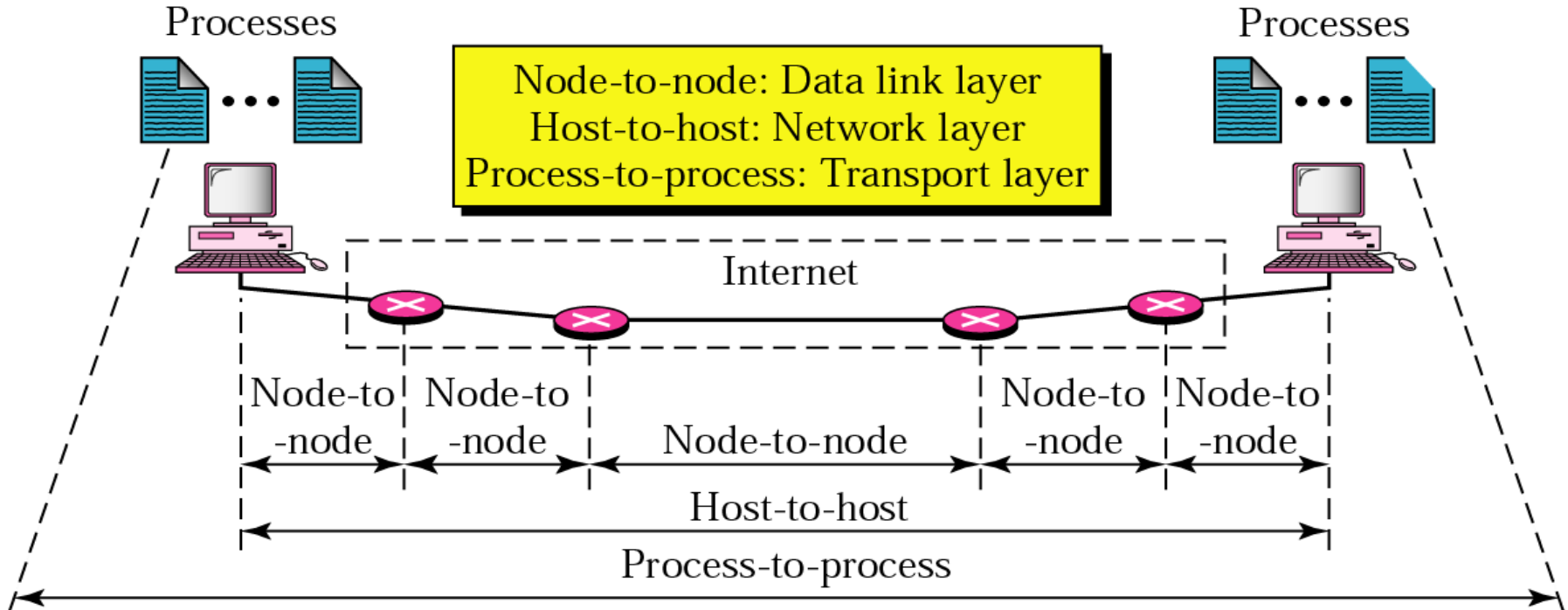
Position of network layer



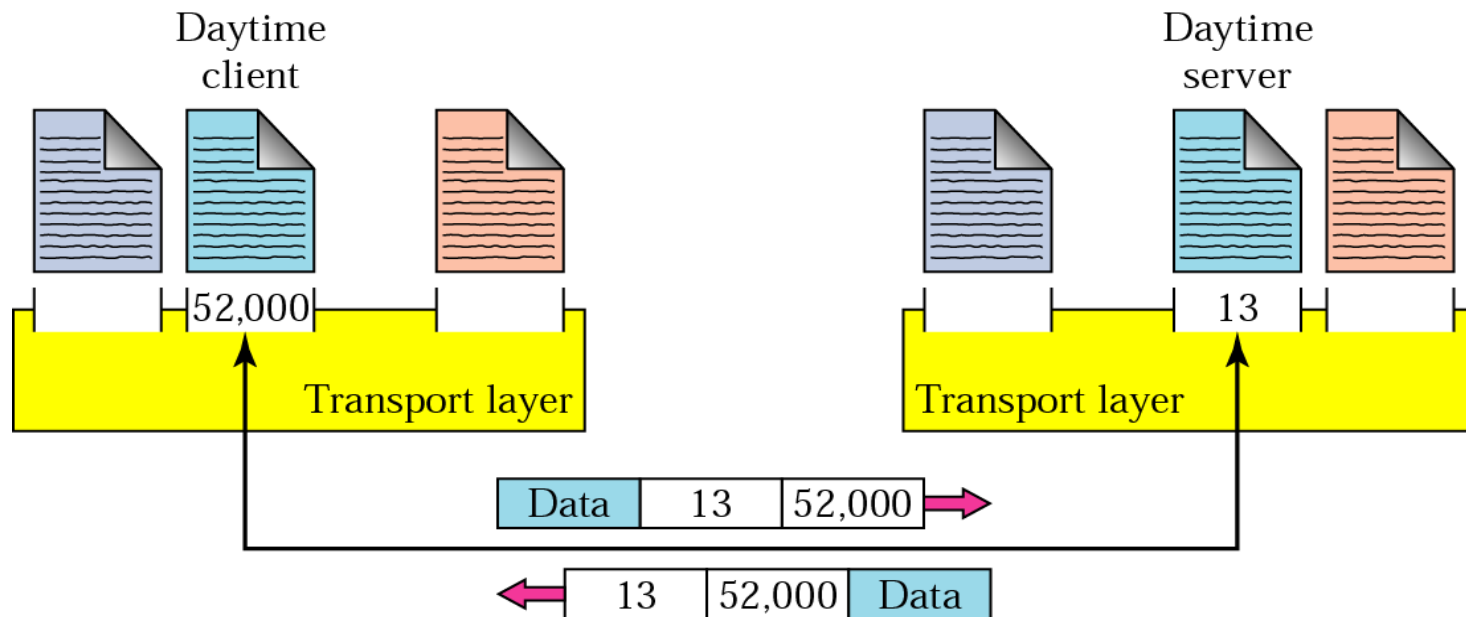
Position of Transport layer



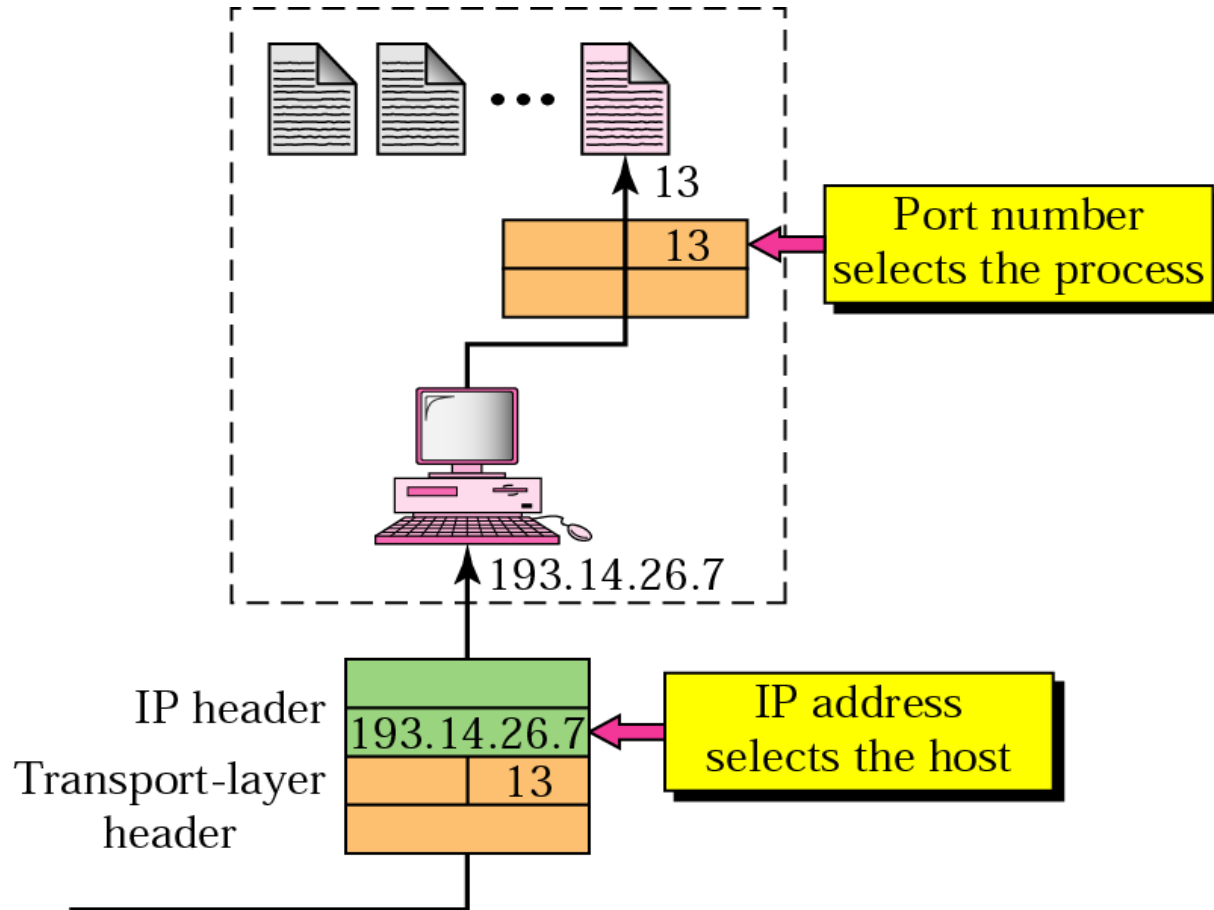
Types of data deliveries



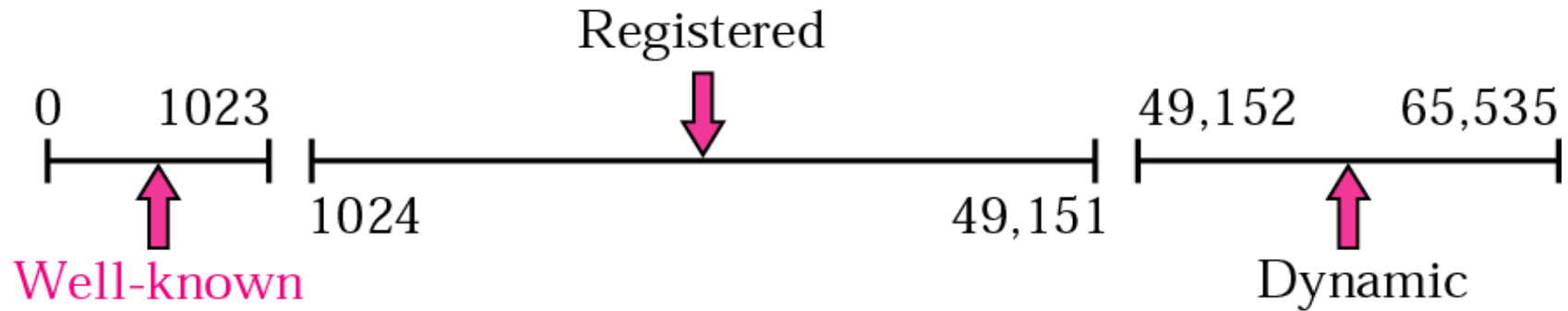
Port numbers



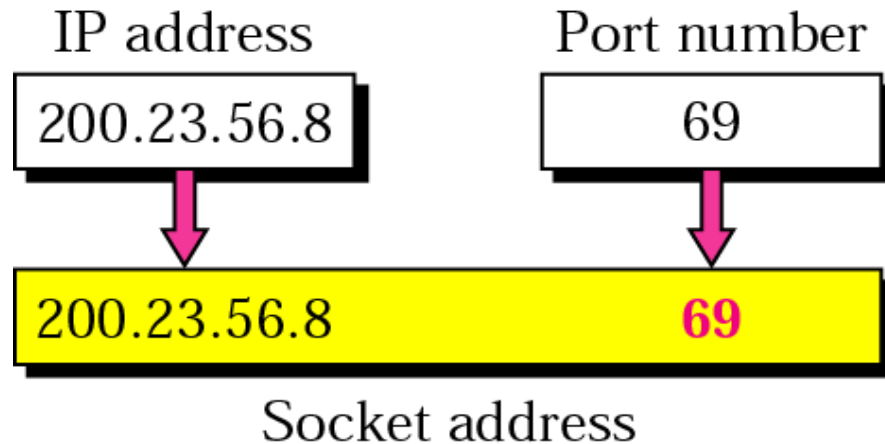
IP addresses versus port numbers



Internet Assigned Number Authority

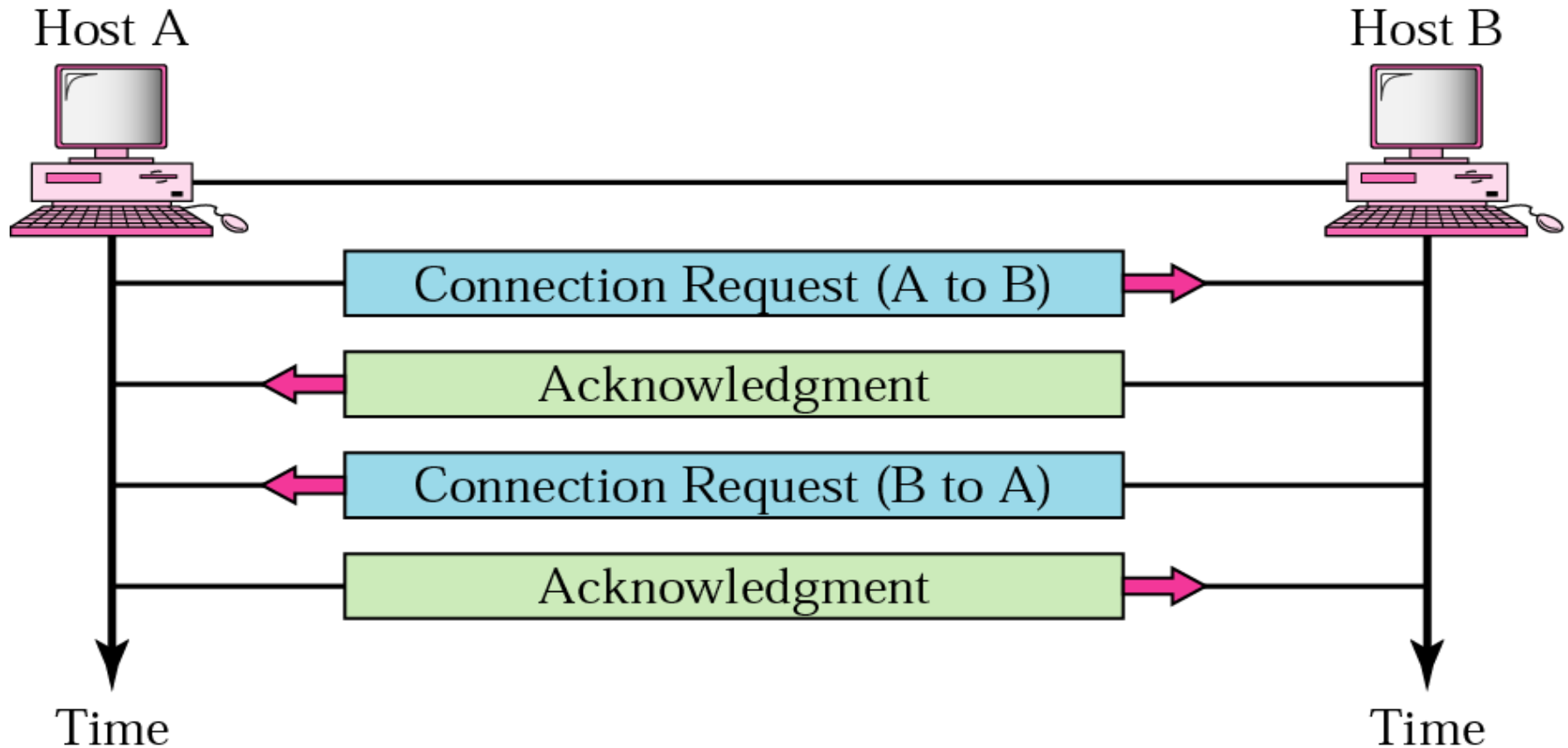


Socket address

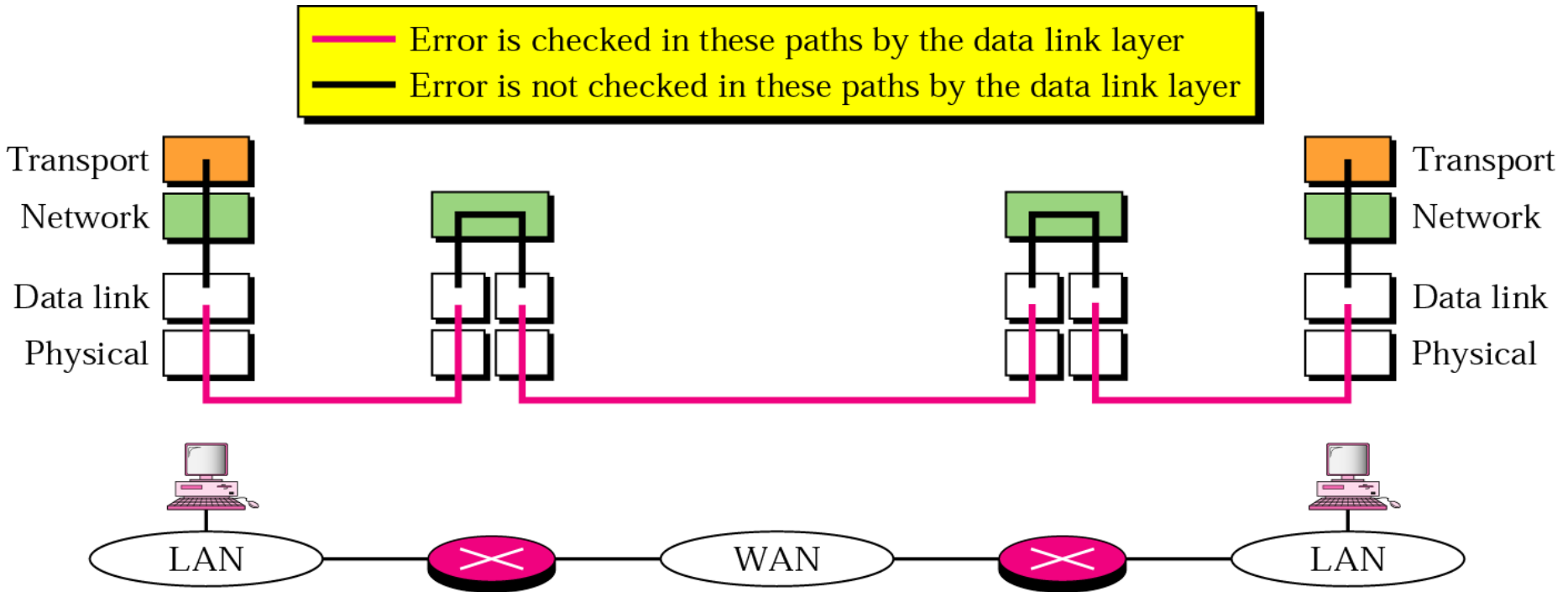


❖ **The combination of ip addr and port number is called a socket address**

Connection establishment



Error control



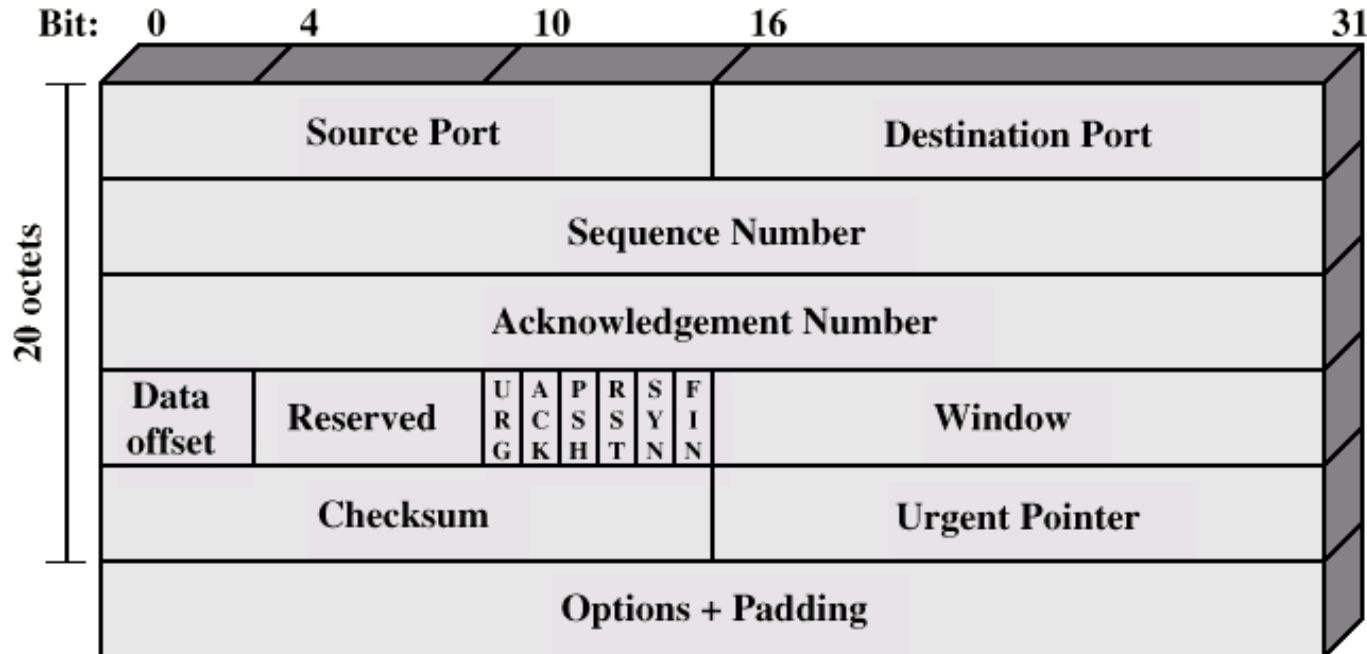
Transport Protocol Mechanisms

- ❖ Logical connection
- ❖ Establishment
- ❖ Maintenance termination
- ❖ Reliable
- ❖ e.g. TCP
- ❖ Transmission Control Protocol
 - Connection oriented
 - RFC 793
- ❖ User Datagram Protocol (UDP)
 - Connectionless
 - RFC 768

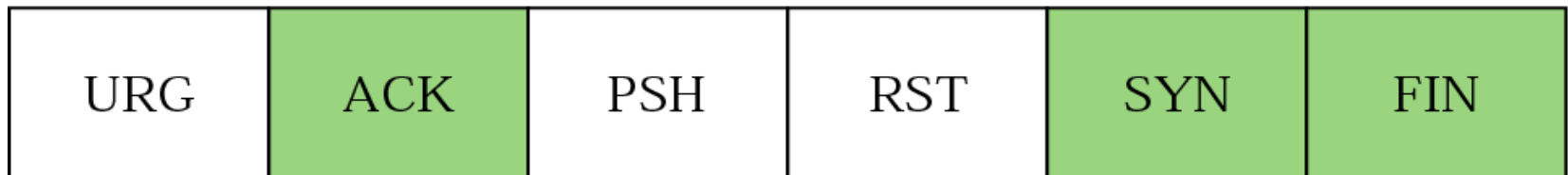
TCP Services

- ❖ **Reliable communication between pairs of processes**
- ❖ **Across variety of reliable and unreliable networks and internets**
- ❖ **Two labeling facilities**
 - **Data stream push**
 - TCP user can require transmission of all data up to push flag
 - Receiver will deliver in same manner
 - Avoids waiting for full buffers
 - **Urgent data signal**
 - Indicates urgent data is upcoming in stream
 - User decides how to handle it

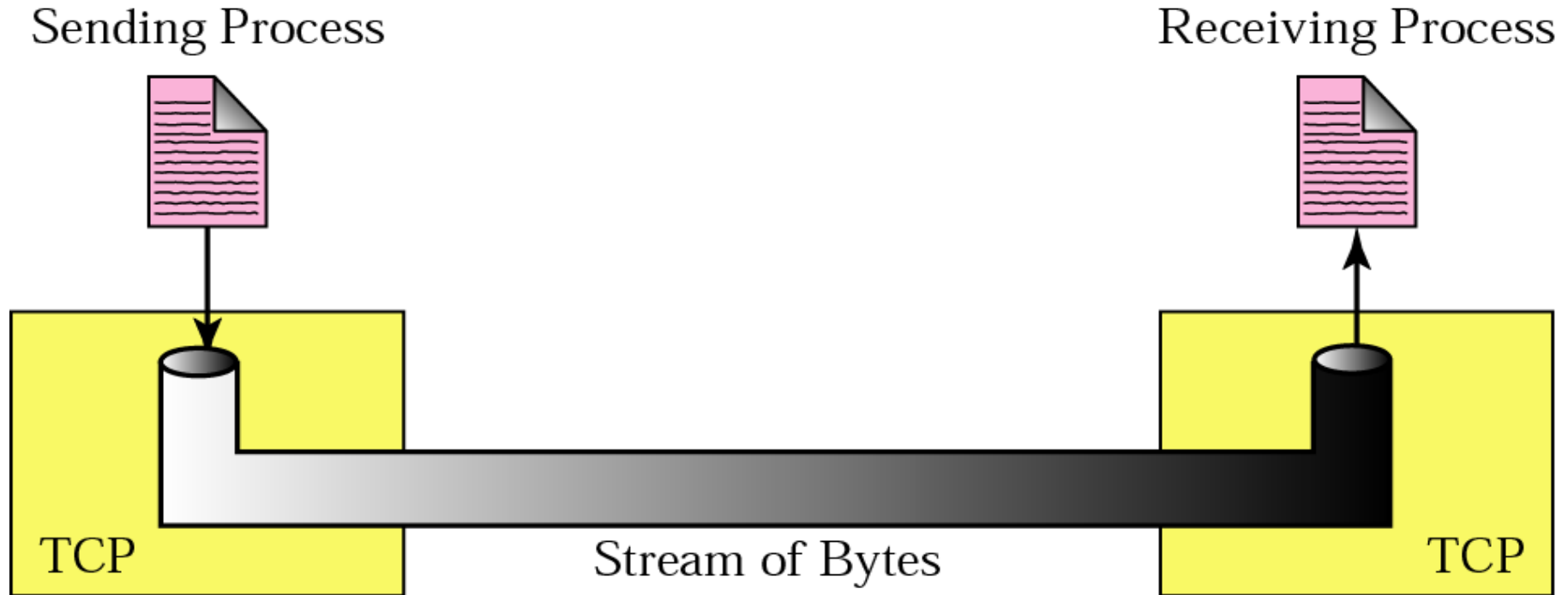
TCP format



URG: Urgent pointer is valid RST: Reset the connection
 ACK: Acknowledgment is valid SYN: Synchronize sequence numbers
 PSH: Request for push FIN: Terminate the connection

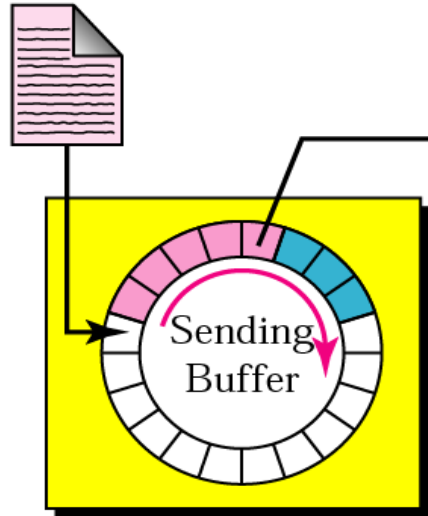


Stream delivery



TCP segments

Sending Process

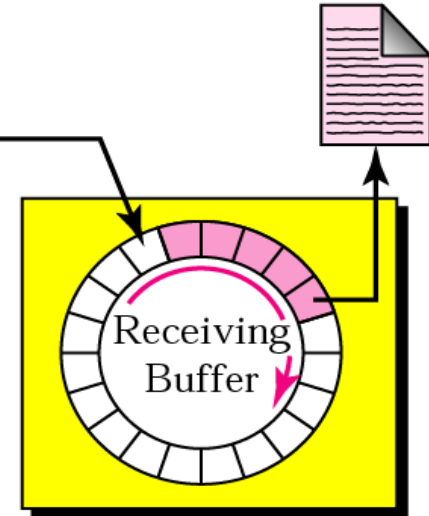


Sending TCP

Segment N Segment 1



Receiving Process



Receiving TCP

TCP segments and Sequence Number

Imagine a TCP connection is transferring a file of 6000 bytes. The first byte is numbered 10010. What are the sequence numbers for each segment if data are sent in five segments with the first four segments carrying 1000 bytes and the last segment carrying 2000 bytes?

The following shows the sequence number for each segment:

- Segment 1 ==> sequence number: 10,010 (range: 10,010 to 11,009)
- Segment 2 ==> sequence number: 11,010 (range: 11,010 to 12,009)
- Segment 3 ==> sequence number: 12,010 (range: 12,010 to 13,009)
- Segment 4 ==> sequence number: 13,010 (range: 13,010 to 14,009)
- Segment 5 ==> sequence number: 14,010 (range: 14,010 to 16,009)

A sliding window is used to make transmission more efficient as well as to control the flow of data so that the destination does not become overwhelmed with data. TCP's sliding windows are byte-oriented.

Items Passed to IP

❖ TCP passes some parameters down to IP

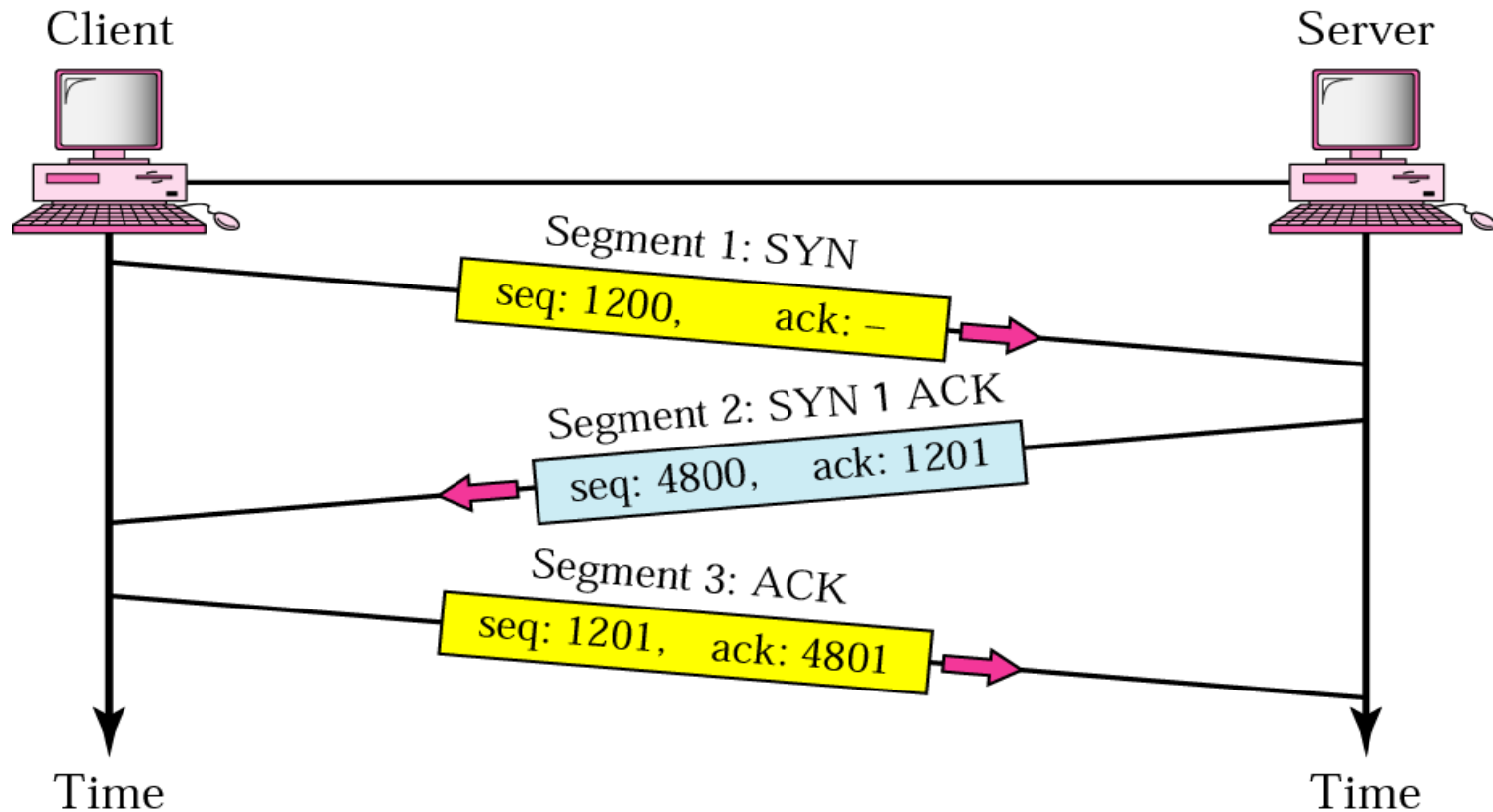
- Precedence
- Normal delay/low delay
- Normal throughput/high throughput
- Normal reliability/high reliability
- Security

TCP Mechanisms

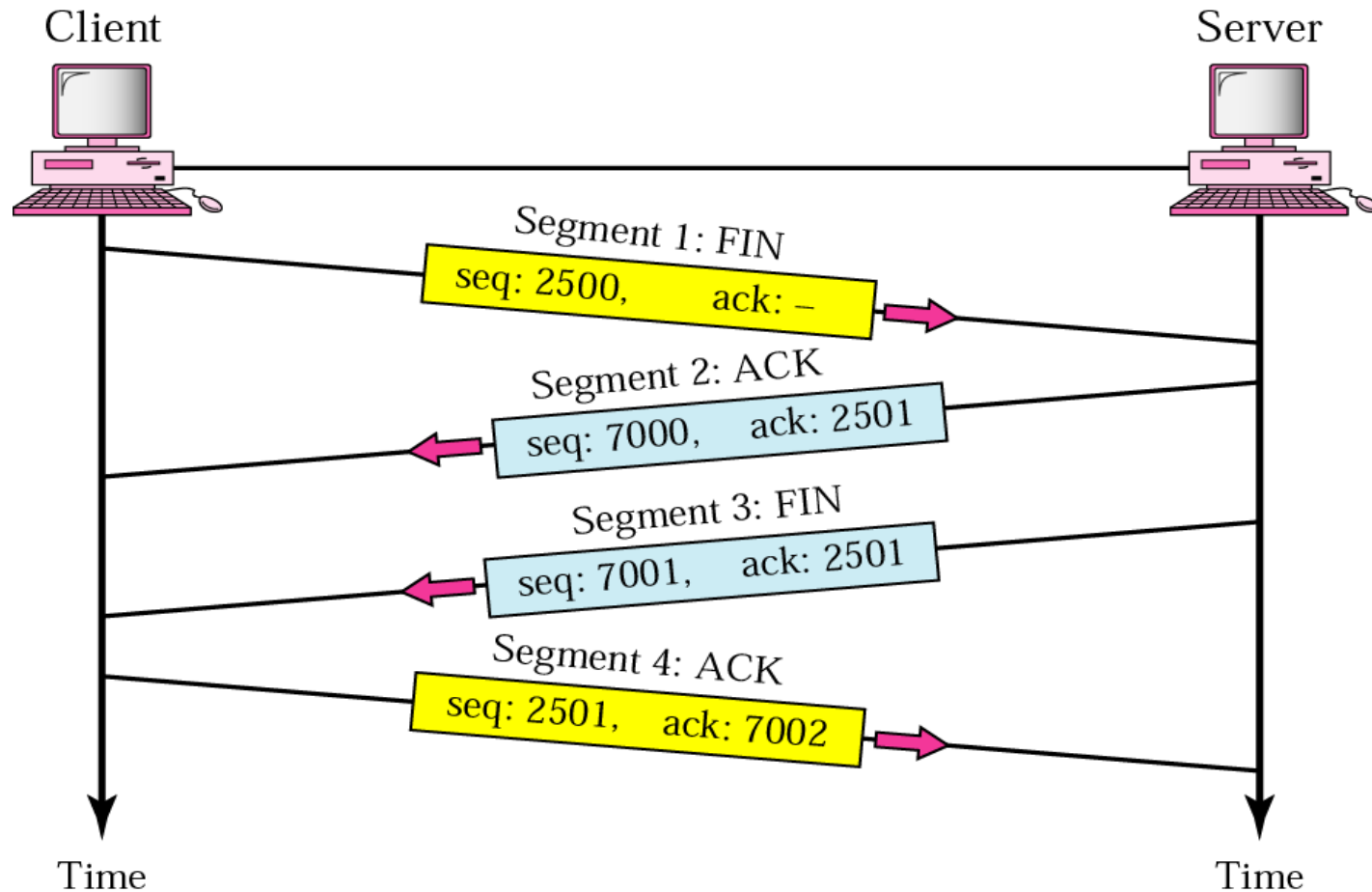
❖ Connection establishment

- Three way handshake
- Between pairs of ports
- One port can connect to multiple destinations

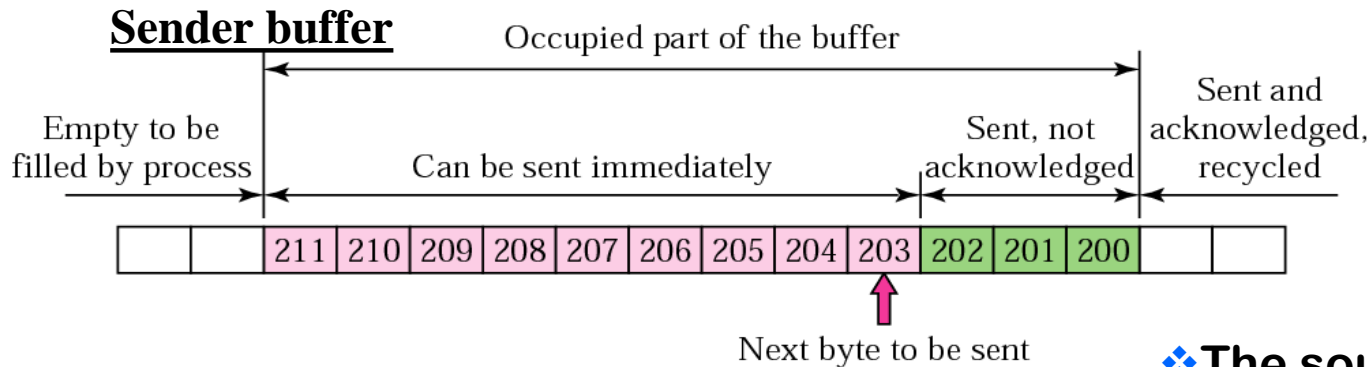
Three-step connection establishment



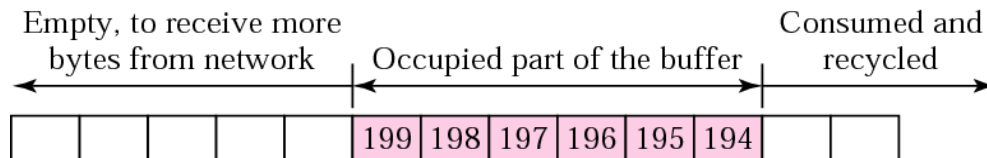
Four-step connection termination



TCP Flow Control



Receiver buffer



❖ The source does not have to send a full window's worth of data.

❖ The size of the window can be increased or decreased by the destination.

❖ In TCP, the sender window size is totally controlled by the receiver window value (the number of empty locations in the receiver buffer). However, the actual window size can be smaller if there is congestion in the network.

UDP -Unreliable Network Service

- ❖ User datagram protocol
- ❖ RFC 768
- ❖ UDP is a connectionless, unreliable protocol that has no flow and error control. It uses port numbers to multiplex data from the application layer.
- ❖ UDP is a convenient transport-layer protocol for applications that provide flow and error control. It is also used by multimedia applications.
- ❖ Reduced overhead
- ❖ e.g. network management

Problems and Complexities of Unreliable Network Service

- ❖ Segments may get lost
- ❖ Segments may arrive out of order

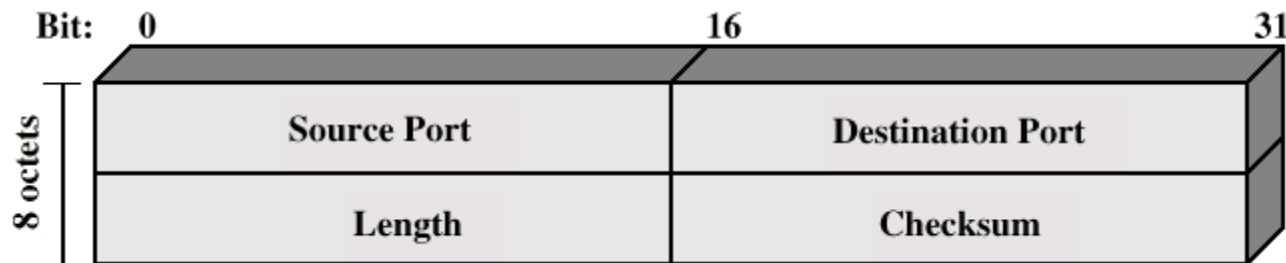
Complexities

- Ordered Delivery, Retransmission strategy
- Duplication detection, Flow control
- Connection establishment, Connection termination
- Crash recovery

Typical UDP Uses

- ❖ Inward data collection
- ❖ Outward data dissemination
- ❖ Request-Response
- ❖ Real time application

UDP Header



Summary

❖ In this lecture, we have:

- Reviewed TCP
- Looked at UDP

Next Time

❖ We will learn

- Understand emerging multimedia applications
- Identify the network services the apps need
- Learn Mechanisms for providing QoS

❖ Suggested Reading:

- Chapter 19 (Stallings)